

Title of Paper: Do finance constraints affect inventory investment decisions of firms? Evidence for the Portuguese manufacturing sector.

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Abstract

In recent years there has been an increasing debate on the determinants of a firm's investment decisions. In fact, according to the investment models that assume perfect capital markets (e.g. Q-Tobin model), the availability of internal funds does not affect investment decisions. Investment outlays in each period are determined in perfectly functioning capital markets. Financial factors are only considered in the cost of capital, which, in turn, is independent of the way in which a firm finances itself (Bond and Meghir, 1994).

On the other hand, the finance constraints model rejects the independence between investment and finance decisions of a firm due to problems of asymmetric information in financial markets. In fact, this model assumes that the participants in financial markets do not share the same information. For example, managers of a particular firm have better information on its future perspectives than potential lenders. As consequence, there is no perfect substitution between a firm's internal and external funds, and this leads to a hierarchy of finance (Myers, 1984), where the cost of internal funds becomes cheaper than the cost of external funds. Therefore, the finance constraints model concludes that the financial status of a firm is a determinant of its investment decisions.

The aim of this paper is to analyse the existence of finance constraints on inventory investment decisions of Portuguese manufacturing firms. To test this impact, a modified version of Lovell's model (1961) was used. The model was extended to include financial variables that are a proxy to the financial position of a firm.

The data used related to the period between 1990 and 2000, and was split into sub-samples based on size, age, and interest coverage ratio to reflect expected differences in the degrees of asymmetric information problems. Furthermore, an econometric inventory investment equation was estimated for each group of firms.

The results of this study showed that, as the finance constraints hypothesis indicates, financial variables have a greater impact on inventory investment decisions of firms that are more subject to information problems in financial markets (e.g., small and young),.

Keywords: Inventory investment, finance constraints, asymmetric information.

1 Introduction

In recent years there has been an increasing debate on the determinants of a firm's investment decisions. In fact, according to the investment models that assume perfect capital markets (e.g. Q-Tobin model), the availability of internal funds does not affect investment decisions. Investment outlays in each period are determined in perfectly functioning capital markets. Financial factors are only considered in the cost of

capital, which, in turn, is independent of the way in which a firm finances itself (Bond and Meghir, 1994).

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The remainder of the paper is organized as follows. Section 2 summarizes the theoretical background of the finance constraints hypothesis. Section 3 describes the empirical study that was undertaken, namely the sample used, the criterion chosen to classify firms, the econometric specification adopted, and the regression results obtained. Finally, section 4 draws the main conclusions of this study.

2 Theoretical Background

According to the neoclassical theories of investment¹, based on the assumption of perfect capital markets, the availability of internal funds does not affect investment decisions of firms. Financial factors are only considered in the cost of capital, which, in turn, is independent of the way in which a firm finances itself. This independence derives from the assumption that capital markets are perfect. Therefore, it is assumed that firms can obtain all the financing they need to implement investment projects, providing that the expected marginal return exceeds the cost of capital.

In other words, it would not be expected that a company, with a profitable investment opportunity but an investment outlay greater than its available funds, would invest less than a company with the same investment opportunities but with greater cash flow. Any resource insufficiency would attract finance in capital markets as investors seek to explore profit opportunities.

As a corollary of this theory, it could be argued that the availability of adequate cash flows is not a restriction to investment and that the financial characteristics of firms do not affect the cost of capital.

However, theoretical developments that emerged in the 1970's on the effects of information problems in financial markets², revised the importance of financial factors (specially, internal finance) in firms' investment decisions. This new theoretical body emphasize that the existence of information problems in financial markets could «create a wedge between the cost of internal and external finance», Carpenter et al (1994: 82).

¹ See, for example, Jorgenson (1963) and Tobin (1969).

² See the works of Jensen and Meckling (1976) and Jensen (1986) on agency theory, and the works of Akerlof (1970), Stiglitz and Weiss (1981), Greenwald et al (1984) and Myers and Majluf (1984) on asymmetric information.

In fact, the costs of external finance for a firm vary inversely with its net worth. Therefore, the retention of profits over the years has a direct impact on investment decisions of firms, given that it contributes to the improvement of a firm's net worth and, as a consequence, it's likely that creditors are more able to lend funds to the firm. In this context, it is expected that firms will incur in higher amount of investment expenses.

These new theoretical contributions can be summarized in the so-called finance constraints model. One can say that a firm faces finance constraints when it can not obtain all the finance it needs, regardless of their opportunity cost. This means that firms face a hierarchy of finance, as a result of the different costs of the sources of financing. According to Myers (1984) a firm begins to use funds with lower costs (internal funds), then it uses debt, and finally, uses the funds with higher costs (new equity issues).

In practical purposes, a firm that faces a severe hierarchy of financing may not be able to obtain external funds to finance its investment plans, due to information problems in financial markets. As a consequence, the firm will be in a situation of under-investment. Carpenter et al (1994: 83) pointed out that «if firms must pay a large premium for new debt or equity, or if they are rationed in external credit markets, internal finance flows from profits and depreciation allowances provide an important source of finance for all kinds of investment.»

3 Empirical Study

The aim of the present empirical study is to determine whether «fluctuations of internal finance are an important cause of changes in inventory investment» (Carpenter et al, 1994: 76).

The focus on inventory investment is justified by the fact that this kind of investment has lower adjustment costs than fixed investment. Hence, it is likely that firms prefer to reduce inventory investment first when confronted with a negative shock on internal finance. Therefore, it would be expected an excess sensitivity of inventory investment to changes in cash flows.

3.1 Sample

In this empirical study a balanced panel data was used which means that firms had to respect several criteria to be included in the sample. Firstly, only private firms, belonging to the manufacturing sector, with at least 20 employees, were considered. Secondly, only companies that presented values for all variables and for every year of the period considered were selected. Finally, outlier values were deleted from the sample. As a result, the total sample comprised 806 firms. The data was provided by the *Central de Balanços do Banco de Portugal*.

As far the variables used in the regression equations is concerned, they were computed from the firms' accounting information and comprised the following: Inventory (I) (includes raw-materials and finished goods); Total assets (TA); Sales (S); Cash flow (CF) (given by the sum of profits and depreciation); Stock of liquid assets (AL) (sum of cash, deposits and marketable securities); Short-term debt (STD) (interest-bearing short-term liabilities of the firm).

3.2 *Criterion to classify firms*

In this study the interest coverage ratio was used to split firms in two groups according to the degree of finance constraints that they face. According to Guariglia (1999: 44) «the coverage ratio can be thought of as a proxy for the premium that firms have to pay for external finance. In particular, one can think of a firm's cost of external funds being a decreasing function of the coverage ratio.»

On the other hand, Mills et al (1995) justify the use of this criterion to classify firms based on the fact that one of the uses of the operating earnings of a firm is to service the debt. Therefore, the higher the indebtedness of a firm, the higher the proportion of its operating earnings that will be used to pay both interest and principal. Hence, if for some reason, there is a decline in a firm's operating earnings, that firm will face difficulties in meeting its obligations and could lead to a cut in its level of investment. Table 1 shows the descriptive statistics for the sub-samples of the firms classified according to the interest coverage ratio.

From this table, it can be observed that both types of firms do not differ much in terms of the mean values of the stock of inventory, total assets, inventory investment and inventory investment ratio. Based on the mean value total assets it appears that both types of firms are identical in terms of size.

The main differences between the two groups of firms are that firms with low interest coverage ratios have, in relation with those with high coverage ones, (a) inventories-total assets ratio 30% higher; (b) cash flow- and liquid assets-total assets ratios 50% lower; (c) short-term debt-sales ratio two times higher. These results may indicate that financial factors have a greater impact on investment inventory for firms with low interest coverage ratios.

3.3 *Econometric specification*

The specification adopted in this study for the econometric inventory investment equation was based on a modified version of Lovell's model (1961).

$$\Delta I_{it} = \alpha_i + \alpha_t + \beta_1 \Delta I_{it-1} + \beta_2 I_{it-1} + \beta_3 S_{it} + \beta_4 S_{it-1} + \beta_5 CF_{it} + \beta_6 LA_{it} + \beta_7 STD_{it} + \varepsilon_{it} \quad (1)$$

where I represents firm's inventory; S corresponds to sales; CF is cash flow; LA represents liquid assets; and ΔSTD is short-term debt of the firm. All variables are divided by total assets (TA) to address the problem of heteroscedasticity. (α_i) corresponds to the firm effect, (α_t) to the time effect and (ε_{it}) is the error term. The subscripts i and t correspond to firm and time, respectively.

The first three explanatory variables aim to capture the stock-adjustment behaviour of firms with respect to inventories, following the rationale of Lovell's model (1961). On the other hand, this serves as a means to control investment opportunities, by isolating the effect of cash flows as a sole financial issue, and not as a proxy for some omitted variable.

The main focus in the analysis of the regression results is the cash flow variable (CF). If, as it is assumed in this study, internal funds are important for investment decisions of firms, the estimated coefficient of the cash flow variable should be statistically significant and have a positive sign.

In spite of the importance of a flow variable (cash-flow) in the context of this study, two stock variables were also included, to reflect more directly the balance sheet effects on investment decisions, as pointed out by Carpenter et al (1994).

One is the liquid assets (LA) variable, which reflects the fact that firms can use their stock of cash to finance the acquisition of inventories. Thus, the estimated coefficient for this variable is expected to have a positive sign, which means that the higher the stock of cash of a firm, the higher is its ability to acquire the inventories needed.

The other variable is short-term debt (STD), which reflects the impact of leverage on the decisions of firms. Therefore, the coefficient estimated for this variable is expected to have a negative sign, which means that the higher the stock of debt of a firm the lower is its ability to invest in inventories.

3.4 *Estimation results*

In this subsection regression results for both low coverage ratio firms and high coverage ratio firms are shown.

The Generalized Method of Moments (GMM) estimation procedure was adopted, given the possible endogeneity of the regressors that may occur as a result of the dynamic nature of the econometric specification, as proposed by Arellano and Bond (1991). All equations were estimated in first differences to eliminate the firm-specific time-invariant effects. Lags of the dependent and explanatory variables were used as instruments.

Table 2 shows regression results for both types of firms.

The main regression results obtained are the following. Firstly, the negative signs of the coefficients estimated for the variable inventories stocks are in accordance with what would be expected in a context of stock adjustment behaviour by firms.

Secondly, as pointed out by Carpenter et al (1994), the negative sign of the coefficient of contemporaneous sales suggests the presence of a buffer-stock effect and the positive sign on the lagged sales is consistent with a positive accelerator effect of inventories.

Thirdly, as expected, the impact of cash flows is higher for low coverage firms than for high coverage firms. In fact, the estimated parameter for the cash flow variable is two and a half times higher for the former than for the latter. This result is in line with the findings of Carpenter et al (1994) and Guariglia (1999)

Fourthly, for both types of firms the coefficient obtained for the variable liquid assets is negative, which is different from what would be expected¹.

Finally, the coefficient of short-term debt is negative as it was expected at the beginning. However, for both types of firms the coefficient estimated is not statistically different from zero.

3.5 *Robustness of results*

An issue that is often raised in the literature related to finance constraints is the possible endogeneity of the criterion used to classify firms. Given that the criterion

¹ A possible explanation for this result is that firms that face finance constraints could view investment in inventories and investment in cash assets as alternative uses of funds. In this context, it would be reasonable to expect a negative sign of the liquid assets variable, reflecting the negative relationship between these two variables. The fact that the estimated coefficient for the variable liquid assets, in absolute value, is much higher for low coverage firms (assumed to face more severe finance constraints) appear to support this explanation.

used in this study – interest coverage ratio – could be subject to this criticism, and also as a way to check the robustness of the results obtained, two other criteria for classifying firms were used.

The first is firms' size, measured by sales. According to this criterion, it is assumed that large firms are, *a priori*, less subject to financial restrictions.

Several reasons may justify the decision to split the sample according to size. Firstly, larger companies have an easier access to capital markets, due to the possibility of using the firm's assets as collateral. Secondly, larger companies can use more different sources of funds than smaller companies, which allows large companies to reduce the risk of financing. Finally, it is likely that small firms suffer more from the idiosyncratic risk.

Table 3 shows the regressions results.

The main finding is that the effect of cash flow on inventory investment is higher for large firms, which is not what would have been expected according to the finance constraints hypothesis. In fact, the estimated coefficient for cash flow is eight times higher for large firms than for small firms. This result raises some doubts on the relevance of the finance constraints hypothesis. Furthermore, it can be seen from table 3 that the short-term debt coefficient, although not statistically significant, has a positive sign for both types of firms.

The second criterion used to classify firms was firms' age (mature firms and young firms). It's assumed that mature firms are less likely to face information problems in capital markets. Two main reasons justify this rationale. Firstly, creditors have, in general, more information about mature firms, since they have been visible for longer period of time in the market. Secondly, mature firms can establish continued relationships with creditors and suppliers based on mutual confidence, which helps overcome information problems.

Table 4 shows regressions results.

With is criterion, the finance constraints hypothesis is again empirically confirmed. In fact, the impact of cash flows on inventory investment is higher for younger firms than for more mature firms. The estimated parameter is forty percent higher for younger firms than for mature firms.

4 Conclusions

In the last two decades there has been a growing interest in the financial determinants of investment decisions of firms. At the beginning, the main focus of attention of researchers was on fixed investment. In recent years researchers started to look at inventory investment also.

The aim of this paper is to contribute to the empirical literature on the financial determinants of inventory investment of firms. In this context, an empirical study was undertaken, using data from a sample of 806 firms belonging to the Portuguese manufacturing sector. To estimate the effects of internal funds on inventory investment decisions of firms, a modified version of Lovell's model (1961) was used. The model was extended to include financial variables that are a proxy to the financial position of a firm.

The findings of this paper appear to support the hypothesis that firms face finance constraints, specially those that show a weak balance sheet position (e.g., low interest coverage ratio) or those that are more subject to information problems in financial markets (e.g. the youngest firms).

In spite of these findings, it is believed that more research is needed to obtain additional empirical evidence to confirm the relevance of financial variables when firms have to decide on its investment expenses.

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Table 1 Descriptive statistics for low and high coverage firms.

Variables	Low coverage ratio		High coverage ratio	
	Mean	S. D.	Mean	S. D.
I ^a	1.705.720	3.927.471	1.519.551	3.705.957
TA ^a	8.487.454	17.833.432	8.920.017	17.089.454
ΔI	84.154	1.427.598	73.268	1.138.559
$\Delta I/TA$	0.0104	0.0760	0.0092	0.0710
I/TA	0.2214	0.1335	0.1736	0.1314
S/TA	1.2048	0.6137	1.4934	0.875
CF/TA	0.0697	0.0762	0.1159	0.0902
LA/TA	0.0444	0.0642	0.0930	0.1111
STD/TA	0.1275	0.1230	0.0637	0.0916

a: values in euros.

Table 2 Regression results for firms classified according to their interest coverage ratio.

Independent variable	ΔI_{it-1}	I_{it-1}	S_{it}	S_{it-1}	CF_{it}	LA_{it}	STD_{it}	Adj. R ²
Low coverage ratio firms	0.069** (0.029)	-0.396* (0.101)	-0.242* (0.032)	0.099* (0.022)	0.295* (0.082)	-0.495* (0.122)	-0.036 (0.073)	0.26
High coverage ratio firms	0.108* (0.035)	-0.559* (0.097)	-0.103* (0.030)	0.056* (0.017)	0.113*** (0.065)	-0.176** (0.085)	-0.149 (0.092)	0.37

Note: Dependent variable, ΔI_{it} . All variables divided by total assets (TA) to account for heteroscedasticity. Standard errors are in parenthesis. Number of observations 3224. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.

Table 3 Regression results for firms classified according to their size

Independent variable	ΔI_{it-1}	I_{it-1}	S_{it}	S_{it-1}	CF_{it}	LA_{it}	STD_{it}	Adj. R ²
Small firms	0.053** (0.027)	-0.445* (0.096)	-0.127* (0.042)	0.054* (0.019)	0.041 (0.062)	-0.420* (0.094)	0.025 (0.098)	0.37
Large firms	0.057 (0.036)	-0.435* (0.143)	-0.161* (0.033)	0.058* (0.015)	0.343* (0.095)	-0.148 (0.110)	0.039 (0.058)	0.31

Note: Dependent variable, ΔI_{it} . All variables divided by total assets (TA) to account for heteroscedasticity. Standard errors are in parenthesis. Number of observations 3224. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.

Table 4 Regression results for firms classified according to their age.

Independent variable	ΔI_{it-1}	I_{it-1}	S_{it}	S_{it-1}	CF_{it}	LA_{it}	STD_{it}	Adj. R ²
Young firms	0.119* (0.030)	-0.597* (0.084)	-0.129* (0.024)	0.062* (0.013)	0.228* (0.072)	-0.202* (0.088)	-0.108 (0.071)	0.39
Mature firms	0.074** (0.031)	-0.219** (0.102)	-0.262* (0.048)	0.091* (0.026)	0.163** (0.090)	-0.267** (0.147)	0.124** (0.074)	0.12

Note: Dependent variable, ΔI_{it} . All variables divided by total assets (TA) to account for heteroscedasticity. Standard errors are in parenthesis. Number of observations 3224. *, ** and *** indicate significance at 1%, 5% and 10% level, respectively.